1.1 (a) IV, (b) II, (c) III.

1.2 Graph it!

1.3 Sketch it!

1.4 Graph it!

1.5 (a) \( r(0) = 8, r(3) = 7 \).
   (b) \( f(2) = 10 \).

1.6 (a) The yield of an apple orchard grows as the amount of fertilizer used till \( a = 40 \) pounds; after that the yields declines while the amount of fertilizer grows.
   (b) The vertical intercept is \( Y = 200 \) bushels corresponds to the yield without fertilizer.
   (c) The horizontal intercept is \( a = 80 \), which corresponds to contamination from fertilizer.
   (d) The range is \([0, 550]\).
   (e) The function is decreasing at \( a = 60 \).
   (f) The graph is concave down.

1.7 (a) \( f(1) = -2 \).
   (b) \( f(5) = 10 \).
   (c) \( x = 3 \).
   (d) The average rate of change is \( \frac{f(4) - f(2)}{4 - 2} = 3 \).

1.8 \( y = 2x - 1 \).

1.9 \( y = -\frac{1}{3}x + \frac{8}{3} = \frac{8-x}{3} \).

1.10 \( y = 2 \)

1.11 \( x = -1 \).

1.12 \( y = 14x - 45 \).

1.13 \( P = 0.4y + 11.3 \).

1.14 (a) \$0.025 or 2.5 cents.
   (b) \( C = \frac{w}{40} + 65 = 0.025w + 65 \).
1.15  (a) 1.8.
(b) \( F = 1.8\ C + 32 \).
(c) \( F = 68^\circ \).
(d) \(-40^\circ \).

1.16  (a) I;
(b) IV;
(c) II and III;
(d) The temperature in graph (III) grows faster.

1.17 Sketch the graph.

1.18  (a) 101 - 11 = 90.
(b) 1.8 units per year.

1.19  (a) 15,854 - 13,673 = 2181.
(b) \( \frac{2181}{3} = 727 \).
(c) No such interval.

1.20 \[
\frac{f(1) - f(-2)}{1 - (-2)} = \frac{3 - 12}{3} = -3.
\]

1.21  (a) 0.22 .
(b) 

\[
\begin{array}{cccc}
99 & -00 & 00 & -01 & 01 & -02 & 02 & -03 \\
0.19 & -0.36 & 0.92 & 0.13 \\
\end{array}
\]
(c) \[
\frac{0.19 + (-0.36) + 0.92 + 0.13}{4} = 0.22.
\]

1.22 Sketch the graphs.

1.23  (a) \( k(t) \), (b) \( h(t) \), (c) \( g(t) \).

1.24 \( y = 2x/5 + 2 \).

1.25 \( y = -3x/7 + 3 \).

1.26 \( y = 4^{x/3} \approx (1.5874)^x \approx e^{0.462x} \).

1.27 \( y = 3 \cdot 3^{t/5} \approx 3 (1.2457)^t \approx 3 e^{0.21072t} \).

1.28 \( y = 2 (\sqrt{2})^{-x} = 2 \cdot 2^{-x/2} = 2 \cdot (1.4142)^{-x} = 2 \cdot (0.7071)^x = 2 e^{-0.34657x} \).

1.29 \( y = 1 - \cos \theta \).
1.30 The average rate of change between \( x = 0 \) and \( x = 10 \) of the function \( y = x \) is 1, of the function \( y = x^2 \) is 10, and of the function \( y = x^4 \) is 1000.

1.31 \( R = kP(L - P) \).

1.32 The function \( g(x) = -3.2x + 30.8 \) is a linear function; the function \( h(x) = 9,000 \left( \frac{3}{5} \right)^{x-1} \) is an exponential function.

1.33 \( y = 2 - (x + 3)^2 \).

1.34 \( y = (x - 2)^2 - 5 \).

1.35 \( x = \ln 11 / \ln 3 \approx 2.182658 \).

1.36 \( x = \ln 0.4 / \ln 1.04 \approx -23.3624 \).

1.37 \( x = \ln 100 / 5 = 2 \ln 10 / 5 \approx 0.9210 \).

1.38 \( x = \frac{1}{3} \ln \frac{10}{25} = \frac{1}{3} \ln \frac{2}{5} = \frac{1}{3} \ln 0.4 \approx -0.3054 \).

1.39 \( P = e^{0.08t} = (e^{0.08})^t = (1.083287068)^t \) and \( Q = e^{-0.3t} = (e^{-0.3})^t = (0.7408182207)^t \).

1.40 (a) \( g(h(x)) = \sqrt{x^4 + 1} \). (b) \( h(g(x)) = x^{3/2} + 1 \). (c) \( h(h(x)) = (x^3 + 1)^3 + 1 \).

1.41 (a) \( g(f(x)) = \ln(2x + 3) \). (b) \( f(g(x)) = 2 \ln x + 3 \). (c) \( f(f(x)) = 4x + 9 \).

1.42 (a) \( f(n) + g(n) = 3n^3 + n - 1 \). (b) \( f(n)g(n) = 3n^3 + 3n^2 - 2n - 2 \).

1.43 The domain of \( f(n)/g(n) \) is the set of all real numbers except \( n = -1 \).

1.44 \( m(z + 1) - m(z) = 2z + 1 \).

1.45 \( m(z + h) - m(z) = 2zh + h^2 \).

1.46 \( m(z + h) - m(z - h) = 4zh \).

1.47 \( f(x) = x^3, g(x) = x + 1 \).

1.48 \( f(x) = x + 1, h(x) = x^3 \).

1.49 (a) \( R(n) = 7 + n \times 1.5 \); (b) \( R(2) = 10 \); \( R(8) = 19 \).

1.50 (a) The cost is \( C = 5000 + n \times 30 \). The revenue is \( R = n \times 50 \).
(b) The marginal cost is $C'' = 30$ dollar per chair. The marginal revenue is $R' = 50$ dollar per chair.

The break-even point is $n = 250$.

1.51 (a) First price list: $C_1(q) = 100 + 0.03q$ dollars.

Second price list: $C_2(q) = 200 + 0.02q$ dollars.

(b) First price list because $C_1(5000) = \$250.00$, but $C_2(5000) = \$300.00$.

(c) $10,000$.

1.52 The budget constraint: $k \geq n_1p_1 + n_2p_2$.

1.53 (a) Roughly 360 scoops; (b) Roughly 120 scoops.

1.54 (a) The equilibrium price is $\$250$ with the quantity $750$.

(b) At price $p = \$300$, suppliers are willing to produce 875; consumer want to buy only 625.

(c) At price $p = \$200$, suppliers are willing to produce 625; consumer want to buy 875.

1.55 (a) $y = 2700 + 486t$; 486 zebra mussels per year.

(b) $y = 2700(1.18)^t$; 18% per year.

1.56 (a) $W = 13559 + 5118.4t$. (b) $W = 13559(1.23624)^t$.

1.57 About 6.80 billion.

1.58 Since the air pressure decays according to the law: $P(h) = P_0 e^{-0.00004 h}$, at the altitude of 7340 feet it will be about 74.557% from the sea level.

1.59 (a) $P = 6t + 60$; (b) $P = 60(1.056)^t$.

1.60 $P = P_0 e^{kt}$, where $P_0 = 10^6 = 1,000,000$ and $k = 0.02$.

1.61 (a) 15%.

(b) $P = 10 (1.1618)^t$.

(c) 16.18% growth.

1.62 (a) $Q(t) = 10.32 2^{-t/12} = 10.32 e^{-t0.057762265}$. (b) $t = \frac{12 \ln 10.32}{\ln 2} \approx 40.4$ days.

1.63 (a) $P(6194)/P_0 = e^{-0.000126194} \approx 0.47555$ or 47.555%. (b) About 23.69%.

1.64 After 12 years, it will remain about 79.37 grams. It will take $t = \frac{8 \ln 10}{\ln 2} \approx 26.575$ years.

1.65 (a) $P(t) = P_0 e^{-0.025t} = P_0 (0.9753)^t$.

(c) The half-life is $t_{1/2} = \frac{\ln 2}{0.025} \approx 27.7258822$.

(d) $e^{-2.5} \approx 0.082$ or 8.2%.
1.66 \( a \) \( H(t) = 2.5 e^{0.84t} \) (in millions). \( b \) 84%.

1.67 Since the population of bacteria grows according to the law \( P(t) = P_0 2^{t/5}, \) where \( t \) is measured in hours, solving the equation \( 2^{t/5} = 3, \) we get \( t = 5 \ln 3 / \ln 2 \approx 7.92 \) or about 8 hours.

1.68 \( a \) Choice 1: Payoff = \$1500 (1.05)^t + \$3000 (1.05)^{t-1} = (1.05)^{t-1} [1500 \times 1.05 + 3000] = \$4575 (1.05)^{t-1}.
Choice 2: Payoff = \$1900 (1.05)^t + \$2500 (1.05)^{t-1} = (1.05)^{t-1} [1900 \times 1.05 + 2500] = \$4495 (1.05)^{t-1}.
\( b \) The interest should be bigger than 25%.

1.69 \( a \) Option 1 is better.
\( b \) Option 1: the future value = \$2000 e^{0.05} = \$2102.54. Option 2: the future value = \$1000 e^{0.05} + \$1000 = \$2051.27. Option 3: the future value = \$2000.
\( c \) Option 1: the present value = \$2000. Option 2: the present value = \$1000 + \$1000 e^{-0.05} = \$1951.229. Option 2: the present value = \$2000, e^{-0.05} = \$1902.458.

1.70 \( f(g(-3)) = f(3) = 0; \ f(g(-2)) = f(2) = 1; \ f(g(-1)) = f(1) = 2; \ f(g(0)) = f(0) = 3; \ f(g(1)) = f(-1) = 2; \ f(g(2)) = f(-2) = 1; \ f(g(3)) = f(-3) = 0. \)
\( g(f(-3)) = g(0) = 0; \ g(f(-2)) = g(1) = -1; \ g(f(-1)) = g(2) = -2; \ g(f(0)) = g(3) = -3; \ g(f(1)) = g(2) = -2; \ g(f(2)) = g(1) = -1; \ g(f(3)) = g(0) = 0. \)

1.71 Graph the Heaviside functions.

1.72 Graph!

1.73 \( 1/200 \) min. or 0.3 seconds.

1.74 \( 2 \sin \left( \frac{x}{4} \right) + 2. \)

1.75 \( -\sin(x) + 2. \)

1.76 The period is one year and the amplitude is 5.

1.77 In the US, the number of cycles is 60 whereas in Europe it is 50. The maximum voltage in the US is 156 volts whereas in Europe it is 339.